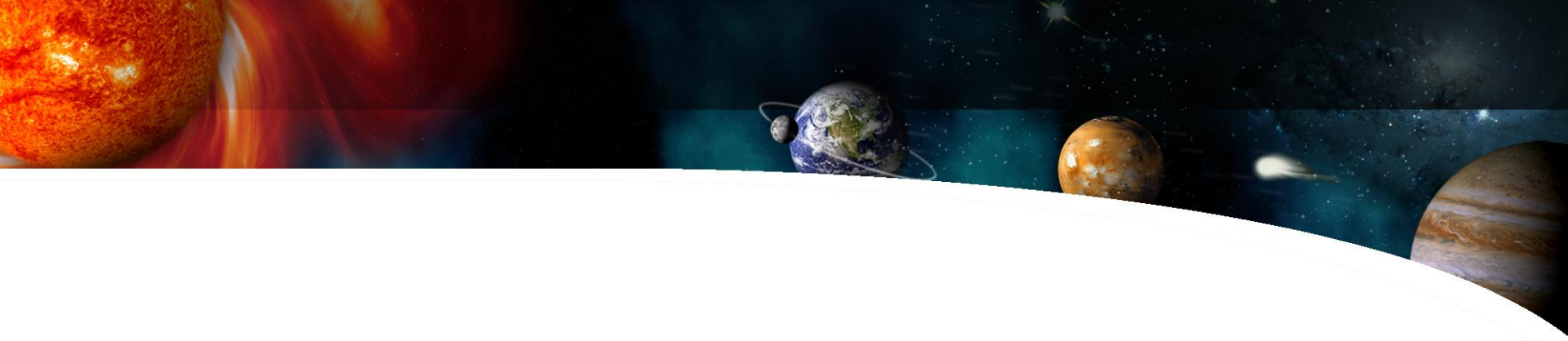


Risk Tolerance (Tailoring and Awareness) and Requirements

Jeff Newmark, Dan Moses
NASA HQ
Mar. 1, 2016

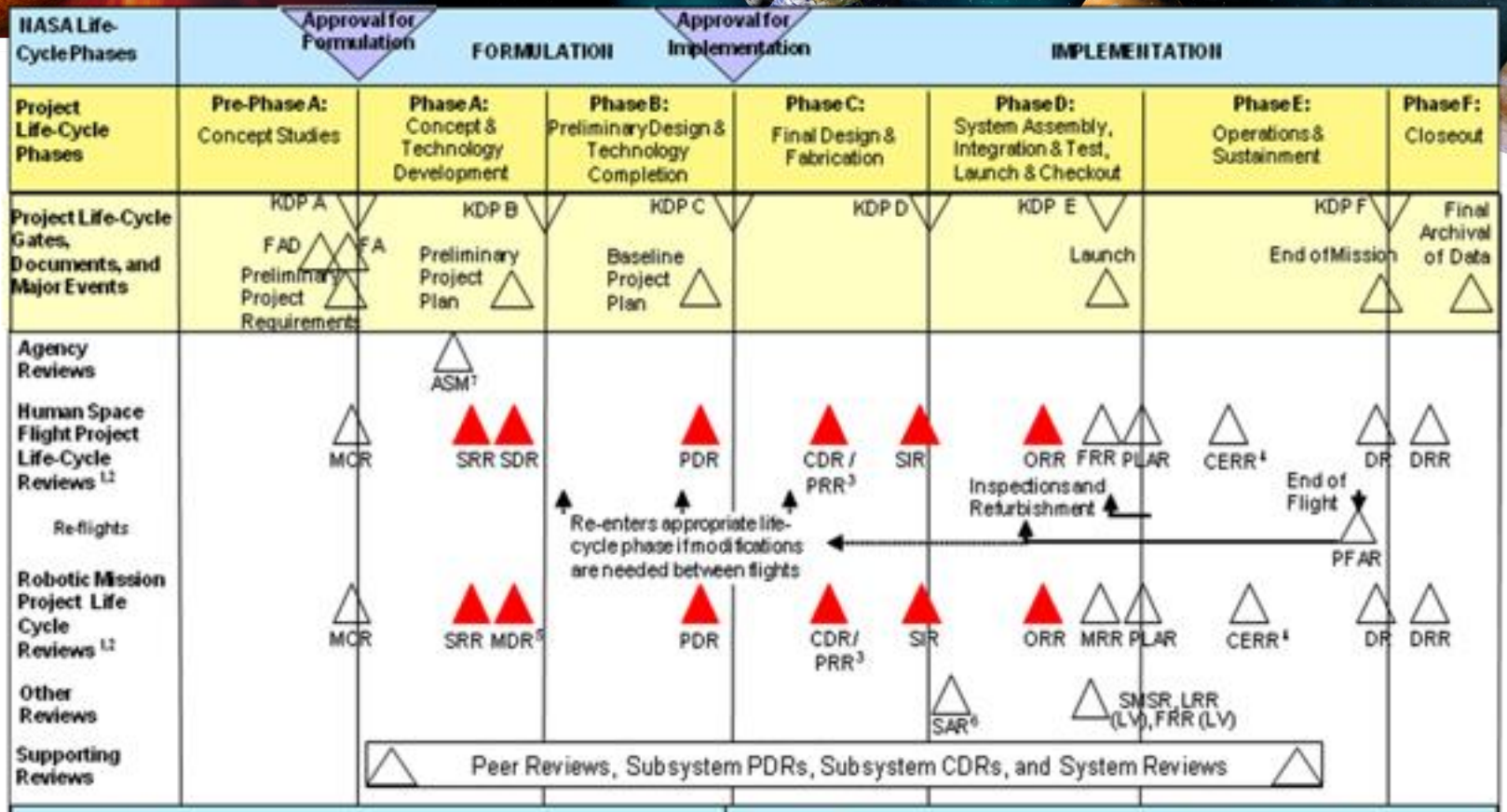
Contents

- Background: Why we care about risk.
- Risk for small, Class-D: Updates, tailored classes, etc.
- ROSES HTIDeS: Implementing risk under 7120.8

Flight Project Governance

- Flight projects are Managed under:
  - NPR 7120.5E
    - Orbital missions – Strategic class and PI-led (e.g. Explorers)
    - Competed through AO
  - NPR 7120.8
    - Suborbital-class including sounding rockets, balloons, sub-orbital reusable launch vehicles (sRLV), ISS payloads, *short duration orbital missions including CubeSats, and others (e.g. DoD STP)*
    - *Competed through ROSES NRA*

7120.5E



FOOTNOTES

1. Flexibility is allowed as to the timing, number, and content of reviews as long as the equivalent information is provided at each KDP and the approach is fully documented in the Project Plan.
2. Life-cycle review objectives and expected maturity states for these reviews and the attendant KDPs are contained in Table 2-5.
3. PRR is needed only when there are multiple copies of systems. It does not require an SRB. Timing is notional.
4. CERRs are established at the discretion of program
5. For robotic missions, the SRR and the MDR may be combined.
6. SAR generally applies to human space flight.
7. Timing of the ASM is determined by the MDAA. It may take place at any time during Phase A.

ACRONYMS

ASM - Acquisition Strategy Meeting
CDR - Critical Design Review
CERR - Critical Events Readiness Review
DR - Decommissioning Review
DRR - Disposal Readiness Review
FA - Formulation Agreement
FAD - Formulation Authorization Document
FRR - Flight Readiness Review
KDP - Key Decision Point
LRR - Launch Readiness Review
LV - Launch Vehicle
MCR – Mission Concept Review
MDR - Mission Definition Review
MRR - Mission Readiness Review
ORR - Operational Readiness Review
PDR - Preliminary Design Review
PFAR - Post-Flight Assessment Review
PLAR - Post-Launch Assessment Review
PRR - Production Readiness Review
SAR - System Acceptance Review
SDR - System Definition Review
SIR - System Integration Review
SMSR - Safety and Mission Success Review
SRB - Standing Review Board
SRR - System Requirements Review

▲ Red triangles represent life-cycle reviews that require SRBs. The Decision Authority, Administrator, MDAA, or Center Director may request the SRB to conduct other reviews.

Environment & External Pressure

- NASA is in the discretionary part of the Federal budget
- Support is generally broad, but the NASA budget is not a “voting issue”
- New content/growth must be accommodated within the available budget
- Greater emphasis has been placed both externally and internally on cost and schedule control
- NASA Authorization Act of 2005
  - Established Nunn-McCurdy type controls on NASA projects
  - Thresholds established for Congressional notification

External Reporting - Threshold Levels

Base-line	Projects Included	Trigger	Threshold	Who Receives	Reports Required
KDP-C	> $75M LCC	Life Cycle Cost	10%	Congress	Notification (only requirement to $75M)
	> $250M LCC	Develop-ment Cost (Phase C-D)	15%	Congress OMB	Notification Threshold Report Analysis of Alternatives Corrective Action Report
			30%	Congress	Rebaseline after legislated authorization to continue
		Key Schedule Milestone	6 months	Congress OMB	Notification Threshold Report Analysis of Alternatives Corrective Action Report
Pre KDP-C (when contract is signed)	$250M LCC & > $50M w/ dev contract	Average Contract Value	15%	Congress OMB	Notification Threshold Report

External Stakeholders
Cost and Schedule Reporting

- Congress and OMB
  - Baseline plan at KDP-C; cost and schedule growth thereafter.
  - Reasons for changes to plan. (Congress asking to improve this reporting.)
  - Any replans
  - Any contracts with development content during formulation
  - New requirement for biannual briefings on major missions for congressional staff
- OMB only
  - Quarterly updates on cost and schedule performance with explanation of change
  - Changes in contract value for contracts with development content during formulation.
- GAO
  - Audits of projects in implementation and projects in formulation with contracts that exceed $50 million.
  - EVM: GAO has requested specific data products to use for their assessment of NASA's EVMS. Examples of the data products include: EVM contract performance reports, IBR reports, IMS, schedule risk analysis, risk management plans, and contract data requirements documents.

NASA Cost & Program Control Practices & Policy

- NPR 7120 and NPD 1000.5
  - Milestone Reviews:
    - KDP-B: Establishing Cost and Schedule Ranges (low & high)
      - Parametric base analysis
    - KDP-C: Establishing Management & Agency Baseline Commitments
      - 70% Joint Cost and Schedule Confidence Level (JCL); with an established MD and project managed UFE/reserve
  - Performance & Program Control through Earn-Value Management (EVM) & Other Mgt Tool
    - Integrated Baseline Review (IBR) - Resource loaded schedules, and/or a better integration of the technical and programmatic
    - Reporting & oversight - objective insights into project cost drivers and final estimated costs at completion.

Confidence Level and Joint Confidence Level (JCL)

- Confidence Levels are established by a probabilistic analysis.
- A Joint Confidence Level is defined as the probability that development cost will be equal to or less than the targeted cost AND the schedule will be equal to or less than the targeted schedule date.
  - Example: A 70 percent confidence level is the point on the joint development cost and schedule probability distribution where there is a 70 percent probability that the program or project will be completed at or lower than the estimated amount and at or before the projected schedule.
- It is an SMD responsibility to demonstrate how we budget and set the LRD at a 70% confidence level; the Project Manager may be (and usually is) given a baseline/budget control below this level
  - There may also be a difference between the targeted launch date given to the Project Manager and the date to which we commit externally

Performance & Program Control Monthly Progress & Periodic Reviews

- Earned Value Management (EVM) is required for all NASA projects >$20M life cycle from KDP-C to KDP-E per NPR 7120.5
  - EVM is an integrated management control system for quantifying, assessing, and understanding what is being achieved with financial resources
  - Integrates cost, schedule, and technical performance with risk management
  - Allows objective assessment and quantification of current project performance
  - Helps predict future performance based on current trends - useful as an “early warning system” for emerging problems
  - Best seen as an “agenda setter” that identifies areas to probe in depth rather than as a system that provides quantitative answers
- Other Program Control Tools: Cost trends, workforce utilization, milestone counting, liens/threats against available reserve

Cat3/ClassD Space Flight Projects Assessment Overview

SMD Program Manager's Summit

October 2015

Ellen Stigberg
Acting Director PPM Division
Office of the Chief Engineer

Background (1 of 2)

Problem Statement:

- Perception that policy and practice is not meeting smaller scale project needs
  - 7120.5 requirements are written for larger scale projects
  - Identify opportunities for tailoring consistency across the Agency
  - Some interpret the policy as too burdensome because they believe they need to apply all requirements
  - Some are not clear on how to tailor or are apprehensive to modify requirements
  - Different Risk posture (e.g., intentionally accepting higher risk)
- Cat 3 and Class D projects cover a wide variety of missions (e.g. Balloons & LCRD in same bucket)

Background (2 of 2)

- NASA AA letter issued Sep 26, 2014 - *Guidance and Expectations for Small Cat3/ClassD Space Flight Projects with a Life Cycle Cost Under $150M.*
- *http://nodis3.gsfc.nasa.gov/OCE_docs/OCE_25.pdf*

Summary of Letter Content (1 of 3)

- Provide guidance and expectations in applying project management requirements to small Cat3/ClassD space flight projects with an LCC under $150M.
- NASA policy recognizes the need to accommodate the unique aspects of each program or project to achieve mission success in a safe, efficient and economical manner within acceptable risk.
- MD's, Centers, support offices, programs and projects are expected to implement and support flexibility for tailoring of requirements for small Cat3/ClassD space flight projects.
- Desired project outcome is for an approved tailoring and implementation approach allowing innovation while maintaining programmatic performance against plan within acceptable risk.

Summary of Letter Content (2 of 3)

- Implementing centers/projects are expected to propose innovative and streamlined implementation approaches for these missions
- Most project products (e.g., control plans) may be included as sections of the Project Plan, or may be a different format other than a separate text document. The products are to be configuration controlled, used by the project to do its work with sufficient content for life-cycle and independent reviews.
- Projects may propose a tailored life cycle review plan and obtain approval from the Decision Authority (DA) to implement. The review plan may include combining, omitting or applying agile approach to the reviews, as approved by the DA.
- An Independent Review Team is used to perform independent assessments of the project in place of a Standing Review Board (SRB).

Summary of Letter Content (3 of 3)

- Governance is consistent with 7120.5E and the delegation of authority decisions per the March 2014 APMC.
  - Mission Directorate Associate Administrators will consider delegation of decision authority of Cat3/ClassD projects at each Key Decision Point (KDP).
  - Projects can propose delegation for MD consideration
- EVM principles for small projects may be applied as per the *EVM Guide for Small Cat 3 Projects* and used for in-house Cat3/ClassD projects a life-cycle cost estimate below $150M.
- JCL and External Cost and Schedule Commitments (ABC external commitment) are not applicable Cat3/ClassD projects with a life-cycle cost below $150M.
  - Cat3/Class D projects are required to develop an NASA internal cost and schedule commitment (ABC internal commitment).
- CADRe is not mandatory but data collection for smaller projects is critical for future estimating capabilities and is strongly encouraged

GSFC Class D initiative

- http://director.gsfc.nasa.gov/classd.html

The guiding principles of a GSFC-led Class D Project initiative are as follows:

- 1. Greater attention upfront to the credibility of proposals and a clear performance floor embodied in a PPIP started early in the flow
- 2. Clear and focused lines of accountability within the team with technical and programmatic authority residing at the Project level wherever feasible
- 3. Short reporting and communication channels within the Project and between the Project and Center decision makers to support timely decisions, with an urgency to protect the schedule using a design- and build-to-cost approach
- 4. Ownership by the team of a product-oriented approach, streamlined processes, minimum distractions, and low overhead
- 5. Expert advice and stewardship to be identified and made available to advise management and Project on the approaches to design- and execution-to-cost

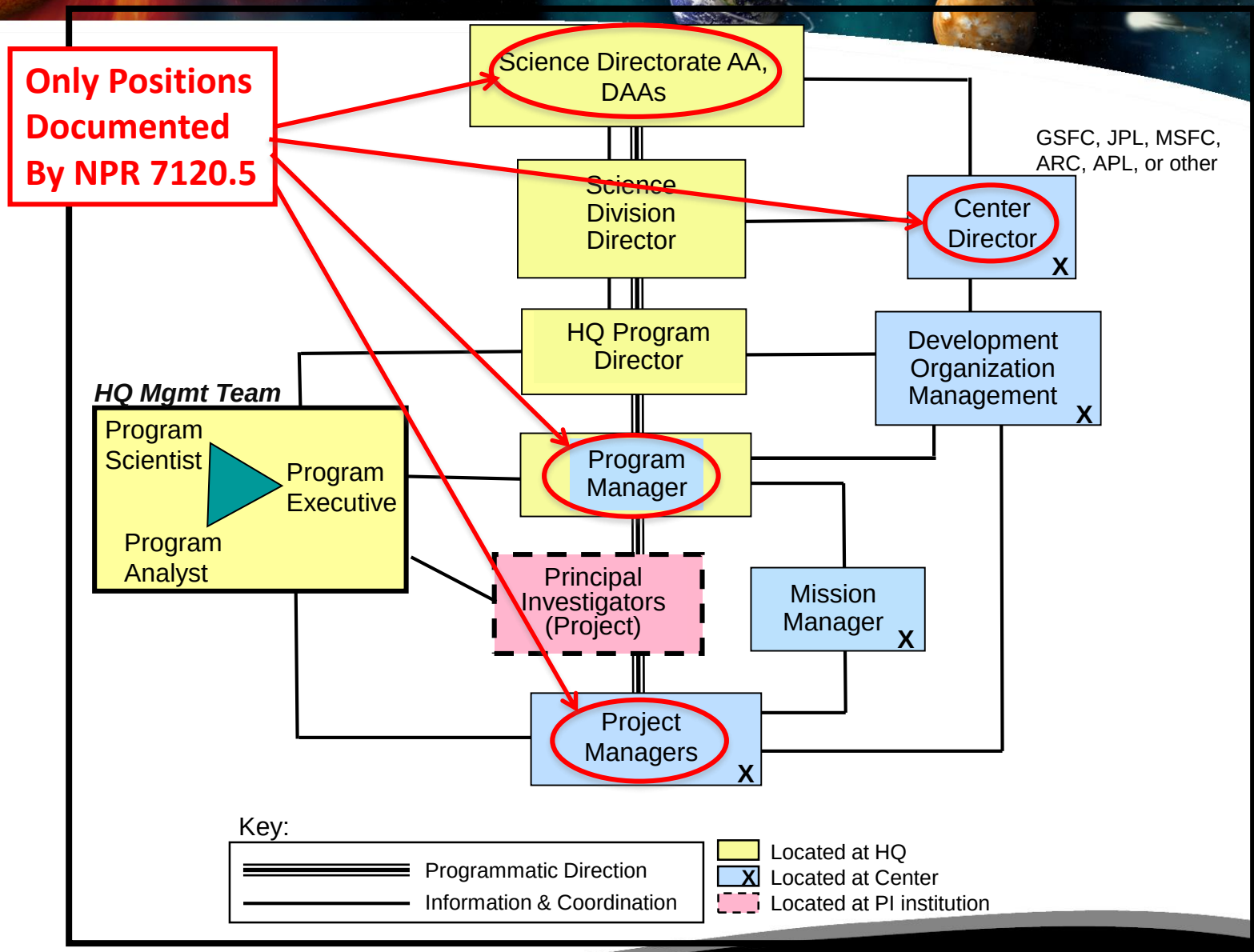
TMC Class C & D Payloads

- http://essp.larc.nasa.gov/EVM-2/pdf_files/OnClassCandClassDPayloadsTMC.pdf

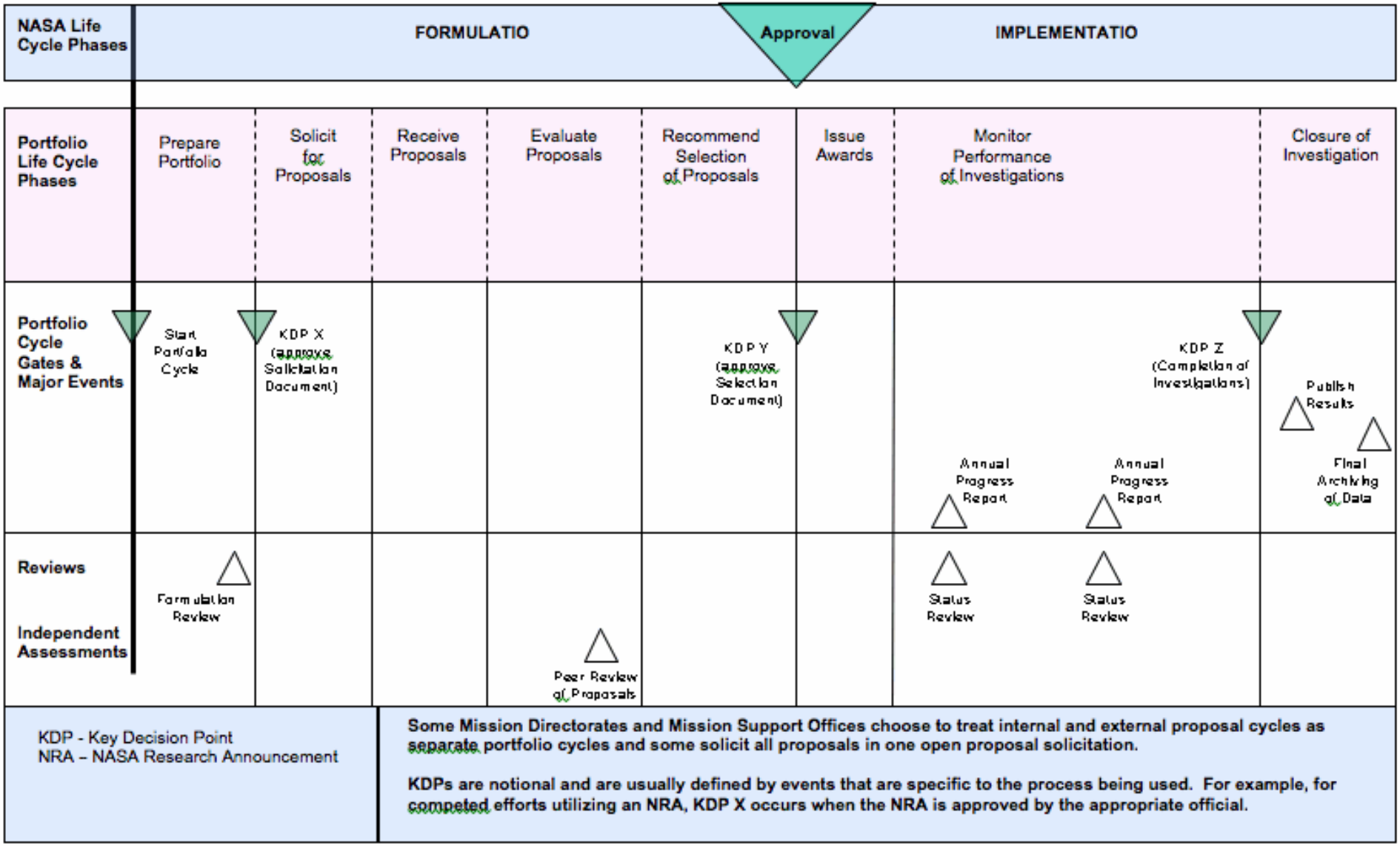
"This document contains guidelines for proposers on proposal content for Class C and Class D payloads."

"May Earth and Space Science mission proposals to NASA go through a Technical, Management, and Cost (TMC) evaluation. This document is intended to assist proposers in understanding the expectations of the TMC Evaluation Panel."

SMD Programmatic Structure (as an Example)



7120.8


NASA Life Cycle Phases
FORMULATIO
Approval
IMPLEMENTATIO
Portfolio Life Cycle Phases
Prepare Portfolio
Solicit for Proposals
Receive Proposals
Evaluate Proposals
Recommend Selection of Proposals
Issue Awards
Monitor Performance of Investigations
Closure of Investigation
Portfolio Cycle Gates & Major Events
Start Portfolio Cycle
KDP X (approve Solicitation Document)
KDP Y (approve Selection Document)
KDP Z (Completion of Investigations)
Publish Results
Final Archiving of Data
Annual Progress Report
Annual Progress Report
Reviews
Independent Assessments
Formulation Review
Peer Review of Proposals
Status Review
Status Review
KDP - Key Decision Point
NRA – NASA Research Announcement
Some Mission Directorates and Mission Support Offices choose to treat internal and external proposal cycles as separate portfolio cycles and some solicit all proposals in one open proposal solicitation.
KDPs are notional and are usually defined by events that are specific to the process being used. For example, for competed efforts utilizing an NRA, KDP X occurs when the NRA is approved by the appropriate official.

Heliophysics Technology and Instrument Development for Science (H-TIDeS)

Low-Cost Access to Space (LCAS): science and/or technology investigations that can be carried out with instruments flown on suborbital sounding rockets, stratospheric balloons, CubeSats, suborbital reusable launch vehicles, or other platforms, collectively referred to as Low-Cost Access to Space.

- Proposals to all H-TIDeS programs shall link the proposed work to the NASA Heliophysics science plan in a three-step process:

  1) NASA Heliophysics Science Goal(s)

  2) The science questions to be answered in achieving the science goals

  3) The proposed investigation objective(s) required to address the science goals (either technological or observational or both)

Proposals to all **H-TIDeS** programs shall link the proposed work to the NASA Heliophysics science plan in a two-step process:

1. NASA Heliophysics Science Goal(s)
2. The derived science questions
3. The proposed investigation objective(s)

1 **NASA's Heliophysics Division's three overarching science goals:**

- Explore the physical processes in the space environment from the Sun to the Earth and throughout the solar system
- Advance our understanding of the connections that link the Sun, the Earth, planetary space environments, and the outer reaches of our solar system
- Develop the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth

Closure is impossible

2 Investigation Science Questions

Do not *require* closure

3 **Investigation's objectives:**

- Observations
- Technology

Do require closure

Investigation Observations

Investigation Technology Developments

No Confusion !
Investigation science questions do *not require* closure!

Low-Cost Access to Space (LCAS)

LCAS Investigation Characteristics:

1. The investigation objectives address NASA Heliophysics Science Goals
2. The investigator develops instrumentation/sensor
3. Spaceflight is required to achieve investigation objectives
4. Data acquired is reduced, analyzed, and interpreted in terms of investigation objectives
5. The reduced (calibrated) data is archived in a NASA on-line facility and the interpretation is published in professional journals
6. The investigation is completed within a time interval less than or equal to four years.
7. The investigation cost is consistent with the available LCAS program funding (Section 4)
8. The Principal Investigator (PI) manages all the program resources (including schedule and cost) and no reserve is held by NASA

LCAS Requirements

The Scientific/Technical/Management section must include the following information:

- The investigation objectives and perceived impact of the proposed work to the state of knowledge in the field; references to existing work in the field should be limited to that which is needed to justify the value of the science proposed;
- A science traceability matrix;
- A general plan of work, the management structure for the proposal personnel, and a description of the expected contribution to the proposed effort by the PI and each person as identified in the proposal - whether or not they derive support from the proposed budget. Postdoctorals and students do not need to be named.
- A discussion of the plan for management, analysis, interpretation, and public dissemination of the data. Note: Level zero observational data from a LCAS flight must be deposited in a NASA-approved data center within 60 days of being obtained and calibrated observational data must be deposited in the same location before the end of the investigation.

HTIDeS Evaluation

Proposals will be evaluated for scientific and technical merit based on the following:

- 1. The importance of the proposed investigation objectives and science question(s) in relationship to the Heliophysics Science goals, including
  - a. the unique value of the investigation to make scientific progress in the context of current understanding in the field,
  - b. the importance of carrying out the investigation now;
- 2. The feasibility of the proposed investigation objectives in answering the science questions and achieving the required technology demonstration and/or observations, including the appropriateness of
  - a. data and/or models,
  - b. facilities,
  - c. instrumentation,
  - d. flight systems
- Based on these two factors, the evaluation will consider the overall potential science impact and probable success of the investigation.
- Note: Proposals are not required to obtain full closure on the science question(s) during the investigation. However, if the investigation does not obtain closure on the science question(s), the proposal must demonstrate the viability of answering those science question(s) through subsequent flights and/or future orbital missions relying on the proposed technologies. Closure on the individual investigation objectives (technology development and/or observations) is required.

LCAS Technical Reporting: DRAFT (1 of 2)

- There is a general expectation that LCAS missions will be conducted in accordance with the launch dates defined in the science proposals.
- Within 90 days of award, the PI shall provide a Project Plan and initial Quad Chart. It is expected this will coincide with the first interaction with the relevant Program Office (e.g. Mission Initiation Conference with the SRPO, Project Initiation Conference with the BPO, the SMD CubeSat Office at NASA HQ, etc.).
- The Project Plan shall identify plans for all technical, schedule, and resource activities for the proposed life of the project.
- The PI shall provide an Interim Review at the end of the first six-month calendar period commencing from the date of award and at twelve-month intervals thereafter.
  - For periods that the PI is holding their own internal review, a review with a NASA Program Office, or the Confirmation Review, those reviews (or brief summaries that include the above information) can be submitted instead of above requirements.

LCAS Technical Reporting: DRAFT (2 of 2)

- The PI shall provide a confirmation review. The purpose of the Confirmation Review is demonstrate the project is ready to move into the final phase (development, integration and test, and flight).
- The PI shall provide an Annual Review at the end of each twelve-month calendar period commencing from the date of award
- The PI shall provide a Final Review at the completion of the activity.